PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

Investigation Report for
Northland Community & Technical College
Thief River Falls

Minnesota
STATE COLLEGES
& UNIVERSITIES

NORTHLAND
COMMUNITY
& TECHNICAL
COLLEGE

7/21/2012

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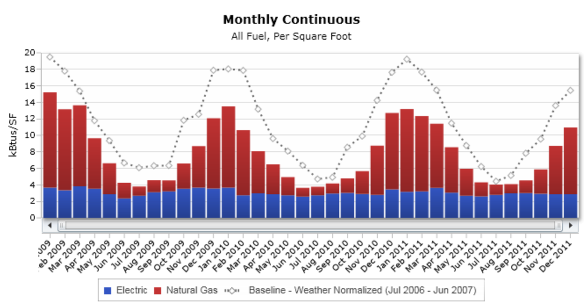
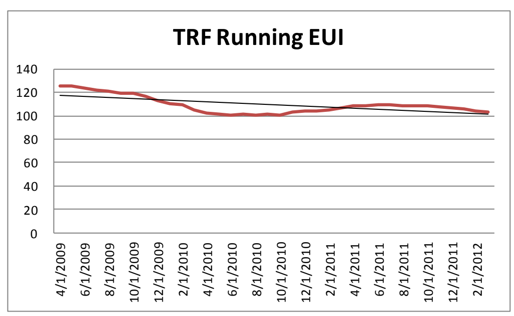
The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of Northland Community & Technical College Thief River Falls was performed by AMEC Earth and Environmental, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total Project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$77,936		Total Project Cost	$104,094
Future costs including Implementation , Measurement & Verification	$26,158		Study and Administrative Cost Paid with ARRA Funds	($80,936)
Total Project Cost	$104,094		Utility Rebates	($0)
			Total costs after co-funding	$23,158
Estimated Annual Total Savings ($)	$1,903		Estimated Annual Total Savings ($)	$1,903
Total Project Payback	54.7		Total Project Payback with co-funding	12.2
Electric Energy Savings	**1.3 %**	**and**	**Gas Energy Savings**	**0.0 %**





Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	201,933	22,794,793	32,986,526	-10,191,732	-31%	$328,212.76	$0.01
2010	365	201,933	20,996,475	31,324,275	-10,327,800	-33%	$295,640.90	$0.01
2011	365	201,933	21,453,472	31,666,448	-10,212,976	-32%	$331,497.36	$0.02

The energy use at Northland College Thief River Falls was unchanged over the period of the investigation.

Summary Tables

Facility Name	Northland Community & Technical College Thief River Falls
Location	1101 Highway 1 East, Thief River Falls, MN 56701
Facility Manager	Clinton Castle, Director of Facilities
Number of Buildings Investigated	11
Interior Square Footage Investigated	206,958
PBEEEP Provider	AMEC Earth and Environmental, Inc.
Study Period	October 2011 through April 2012
Annual Energy Cost	$331,497 (2011)
Utility Company	Electric: Thief River Falls Municipal Utility Natural Gas: Minnesota Energy Resources
Site Energy Use Index (EUI)	104 kBtu/sq ft(2010, start of study) 103 kBtu/sq ft(2011/2, end of study)
Benchmark EUI (from B3)	130 kBtu/sq ft

Building Data as listed in B3

Building Name	State ID	Area (Square Feet)	Year Built
Activities	E26356C1971	23,700	1971
Administration-Library	E26356C0269	15,455	1969
Development Learning Center	E26356C1502	6,733	2001
Development Learning Center	E26356C1401	3,367	2001
Fine Arts	E26356C0471	18,800	1971
Main Building	E26355T0267	45,384	1967
Science	E26356C0169	10,696	1969
Shop/Café/Cosmo	E26355T0478	50,956	1978
Student Commons-Classrooms	E26356C1300	16,123	2000
Workforce Center	E26355T2006	5,200	2007
MEC Center	E26356C1299	10,544	1999

Mechanical Equipment Included in Investigation: Summary Table	
Total	**Equipment Description**
2	Building Automation Systems (TAC and Metasys)
11	Buildings
206,958	Interior Square Feet
22	Air Handlers (3 in MECC)
2	Rooftop Units
43	Digital VAV Boxes
~15	Pneumatic VAV Boxes
29	Exhaust Fans
16	Unit Heaters and Cabinet Unit Heaters
2	Make-up Air Units
1	Chiller
10	Hot Water Boilers (4 in MECC)
15	Pumps (HW, CHW, etc) (2 in MECC)
4	Heat Exchangers
1	Air Compressor
740	Approximate Number of Points Available for Trending
490	Points Required for Trending
90	Data Loggers Required (approximately 10 motor status and 80 temperature). Does NOT include any necessary lighting loggers.

Implementation Information			
Estimated Annual Total Savings ($)			$1,903
Total Estimated Implementation Cost ($)			$23,158
GHG Avoided in U.S Tons (CO2e)			28
Electric Energy Savings (kWh) (2011 Usage 1,524,677 kWh)		1.5 % Savings	33,153
Electric Demand Savings (kW) (2011 peak demand 750kW)			5
Gas Energy Savings (Therms) (2011 Usage was 94,180 Therms)		0 % Savings	0
Statistics			
Number of Measures identified			4
Number of Measures with payback < 3 years			0
Screening Start Date	01/20/2011	Screening End Date	02/08/2011
Investigation Start Date	8/19/2011	Investigation End Date	3/16/2012
Final Report	7/11/2012		

Northland Community College, Thief River Falls Cost Information			
Phase		**To date**	**Estimated Future Cost**
Screening		$2,160	
Investigation [Provider]		$55,345	
Investigation [CEE]		$6,013	$1,000
Implementation			$19,244
Implementation [CEE]			$1,000
Measurement & Verification			$1,000
Total		$63,518	$22,244

Co-funding Summary	
Study and Administrative Cost	$66,518
Utility Co-Funding - Estimated Total ($)	$0
Total Co-funding ($)	$66,518

Northland Community & Technical College Thief River Falls Overview

The energy investigation identified 0.5% of total energy savings at Northland Community & Technical College Thief River Falls with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at Northland Community & Technical College Thief River Falls include upgrading lighting fixtures with more efficient or lower wattage bulbs and replacing three way valves with two way valves on the hot water distribution system. The total cost of implementing all the measures is $19,244.

Implementing all these measures can save the facility approximately $1,674 a year. During the period of the PBEEEP investigation energy use at Northland Community & Technical College Thief River Falls decreased approximately 18% compared to the year prior to the study. It is now 21% below the benchmark value according to the Minnesota Benchmarking and Beyond database (B3).

Northland Community and Technical College (NCTC) in Thief River Falls is comprised of two campus locations. The Main Campus is made up of nineteen buildings totaling 232,455 square feet. Ten of the buildings are attached and make up the Main Building and the remaining nine are smaller detached buildings. The Airport Campus is made up of five buildings, four of which are attached, and totals 89,252 square feet. The two campuses are at separate locations, approximately five miles apart. This investigation covered only the main campus.

Mechanical Equipment

There are a total of 22 air handlers and two rooftop units located throughout the Main Building. There are two boiler rooms that supply hot water to a loop that circulates hot water to the air handlers and reheats located throughout the building. The East and West Boiler rooms each have three hot water boilers. An air-cooled chiller provides chilled water to cooling coils in five of the air handlers. Eleven of the air handlers and both rooftop units have direct expansion (DX) cooling while the remaining six air handlers do not provide cooling. There are approximately 58 VAV boxes with hot water reheat, approximately 15 of which are pneumatically controlled and actuated, while the rest are digital.

The Multi-Event Cultural (MEC) Center has four small boilers and two pumps that produce and deliver hot water to three air handlers. The air handlers provide heating to the spaces, but no cooling. The equipment in the building is oversized because the building was meant to be expanded in phases, with the current structure being the first of three phases. The equipment was sized to handle the load of a much larger space, but there are no longer plans to expand the facility. Variable Frequency Drives (VFDs) were installed recently on the supply fan motors of all of the air handlers to help resolve this issue.

Controls and Trending

The Main Campus originally had a Johnson Controls Metasys Building Automation System (BAS) that controlled most of the equipment in the facility. Recently a new TAC Niagara front end was installed that communicates with the existing controllers and new controllers were installed. The Niagara system is capable of trending, although is it not currently set up for trending and will require set up by a controls technician. The Metasys system is also capable of trending. Since some of the equipment is still controlled by the Metasys system, trending all of the equipment in the facility will require setting up trends on both systems. The trend data can be exported from both systems in a usable format for spreadsheet analysis. Approximately 65% of the equipment in the Main Building is controlled by both systems. The equipment that is neither controlled or monitored by either BAS are seven air handlers and approximately 15 Variable Air Volume (VAV) boxes that are pneumatically controlled and actuated. These items of equipment will require the use of data loggers to collect trend data. All of the equipment in the MEC Center is controlled by the TAC system. The points for each building in the automation system are listed in the following building summary tables.

Lighting

The majority of interior lighting on campus is 32 watt T8s. The MEC Center also has exterior scoreboard lighting and field lights.

Energy Use Index and B3 Benchmark

The site Energy Use Index (EUI) for the Main Campus is 103 kBtu/sqft, which is 21% lower than the B3 Benchmark of 130 kBtu/sqft. This includes the four storage sheds and the Criminal Justice Building, so these values are not for the Main Building alone. The site Energy Use Index (EUI) for the MEC Center is 68 kBtu/sqft, which is 39% lower than the B3 Benchmark of 111 kBtu/sqft. The median site EUI for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks.

Metering

The Main Building has two electric and five natural gas meters, which also serves some of the small detached buildings on campus, so the Main Building is not individually metered. The MEC Center is individually metered and has one electric and one natural gas meter.

Findings Summary

Building: Main Building
Site: Northland CTC TRF

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
3	32 Watt T8 Lighting.	$4,097	$519	7.90	$0	7.90	5
5	32 Watt T8 Lighting.	$1,512	$165	9.14	$0	9.14	1
2	Pump Speed doesn't vary sufficiently	$14,169	$998	14.20	$0	14.20	20
4	32 Watt T8 Lighting.	$3,381	$221	15.28	$0	15.28	2
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$23,158**	**$1,903**	**12.17**	**$0**	**12.17**	**28**

PBEEEP was made possible with funding from the U.S. Department of Energy
and the MN Department of Commerce.

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Rev. 2.0 (12/16/2010)

15201 - Northland CTC- TRF Main Building

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	AHU 3, 9		AHU 3 and 9 are constantly running.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Investigation looked for, but did not find this issue.	
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Not Relevant	
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	
	b.3 (7)	OTHER_Economizer/OA Loads			Not Relevant	
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Not Relevant	
	c.4 (11)	OTHER_Controls			Not Relevant	
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Investigation looked for, but did not find this issue.	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	X	Hot Water Pumps		Replace existing three way valves with two way valves on AHUs 6, 7, 8, 14, 17, & 18
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)			Not Relevant	
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	X	AHU 1, 3, 6, 10		Hot Deck and Cold Deck temps are sub-optimal.
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)			Not Relevant	
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Investigation looked for, but did not find this issue.	
	f.2 (24)	Pump Discharge Throttled	X	Chilled Water Pumps		Valves have been manually closed due to the lack of variable flow on the pumps.
	f.3 (25)	Over-Pumping	X	Chilled Water Pumps		Valves have been manually closed due to the lack of variable flow on the pumps.
	f.4 (26)	Equipment is oversized for load.	X	AHU 6		Hot water valves are 50% manually closed on the inlet and outlet sides.
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Not Relevant	
	g.1 (28)	VFD Retrofit - Fans			Investigation looked for, but did not find this issue.	

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Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps	X	Chilled Water Pumps		Install VFDs on chilled water pumps and install 2 way valves at AHUs. 2 15 hp CHW Pumps
	g.3 (30)	VFD Retrofit - Motors (process)			Investigation looked for, but did not find this issue.	
	g.4 (31)	OTHER_VFD			Not Relevant	
h. Retrofits:	h.1 (32)	Retrofit - Motors			Investigation looked for, but did not find this issue.	
	h.2 (33)	Retrofit - Chillers			Investigation looked for, but did not find this issue.	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Investigation looked for, but did not find this issue.	
	h.4 (35)	Retrofit - Boilers			Investigation looked for, but did not find this issue.	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not Relevant	
	h.7 (38)	Retrofit - Equipment (custom)			Not Relevant	
	h.8 (39)	Retrofit - Pumping distribution method			Investigation looked for, but did not find this issue.	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not cost-effective to investigate	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Hallways		Install 28 watt fluorescent lamps in the hallways.
	h.12 (43)	Retrofit - Building Envelope			Not Relevant	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not Relevant	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not Relevant	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Not Relevant	
	i.4 ( )	Leaky/Stuck Valve			Not Relevant	
	i.5 (48)	OTHER_Maintenance			Not Relevant	
j. OTHER	j.1 (49)	OTHER			Not Relevant	

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**
	• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**
	• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**
	• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**
	• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**
	• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**
	• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**
	• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**
	• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**
	• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**
	• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**
	• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**
	• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**
	• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**	
		• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**	
		• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**	
		• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**	
		• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**	
		• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**	
		• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**	
		• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**	
		• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**	
		• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**	
		• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**	
		• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**	
		• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**	
		• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**	
		• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**	
		• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**	
		• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**	
		• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**	
		• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**	
		• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**	
		• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**	
		• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**	
		• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**	
		• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**	
		• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**	
		• Please contact PBEEEP Project Engineer for approval

Findings Details

Building: Main Building

FWB Number:	15201	Eco Number:	2
Site:	Northland CTC TRF	Date/Time Created:	7/10/2012

Investigation Finding:	Pump Speed doesn't vary sufficiently	Date Identified:	1/4/2012
Description of Finding:	The secondary hot water pumps do not vary enough for the variable flow system.		
Equipment or System(s):	Pump, HW distribution	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Pump Speed Doesn't Vary Sufficiently		

Implementer:	Lighting contractor	Benefits:	Energy savings
Baseline Documentation Method:	Observe pump speeds during baseline operation. Trended the valve position of the three way valves on the air handling units, the outside air temperature and the pump speeds.		
Measure:	Replace existing three way hot water valves on AHUs 6, 7, 8, 14, 17 and 18 with two way valves.		
Recommendation for Implementation:	Replace the 3W HW valves on six air handling units with 2W valves. There will be a bypass out in the piping system to assure there is enough water flowing through the system at all times. A balancer will have to balance the hot water system and determine a differential pressure setpoint which is adequate to deliver the design amount of hot water if all the coils were 100% open. Ideally the pump would run at 100% when all HW valves are open and run at minimum speed when all valves are closed and water is only be distributed through the bypass.		
Evidence of Implementation Method:	The hot water valve position on all the AHUs associated with the pump will be trended as well as HWP1 speed, HWP2 speed, Differential pressure, and Differential pressure setpoint. The system will be trended for a two week period when it is colder outside (0 F) to show when many valves within the system are open the pump is running at or near maximum speed. The same points will be trended when it is warmer outside (above 40 F) for a two week period to show when many of the HW valves are closed the system is running at a minimum speed.		

Annual Electric Savings (kWh):	23,204	Contractor Cost ($):	$12,880
Estimated Annual kWh Savings ($):	$998	PBEEEP Provider Cost for Implementation Assistance ($):	$1,288
		Total Estimated Implementation Cost ($):	$14,169

Estimated Annual Total Savings ($):	$998	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	14.20	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	14.20	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	20	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	52.4%	Percent of Implementation Costs:	61.2%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Main Building

FWB Number:	15201	Eco Number:	3
Site:	Northland CTC TRF	Date/Time Created:	7/10/2012

Investigation Finding:	32 Watt T8 Lighting.	Date Identified:	2/16/2012
Description of Finding:	32 Watt T8 Lamps were found throughout the hallways.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy savings and load reduction
Baseline Documentation Method:	Visual inspection of the lamps concluded 32 watt T8 lamps are being installed.		
Measure:	Replace 32 watt lamps with 28 watt lamps.		
Recommendation for Implementation:	Replace the 32 watt T8 lamps with 28 watt T8 lamps throughout the hallways.		
Evidence of Implementation Method:	Visually inspect the lamps to ensure 28 watt T8 lamps are being installed.		

Annual Electric Savings (kWh):	5,612	Peak Demand Savings (kWh):	2
Estimated Annual kWh Savings ($):	$241	Estimated Annual Demand Savings ($):	$278
Contractor Cost ($):	$3,725		
PBEEEP Provider Cost for Implementation Assistance ($):	$372		
Total Estimated Implementation Cost ($):	$4,097		

Estimated Annual Total Savings ($):	$519	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	7.90	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	7.90	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	5	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	27.3%	Percent of Implementation Costs:	17.7%

Findings Details

PBEEEP State Government

Building: Main Building

FWB Number:	15201	Eco Number:	4
Site:	Northland CTC TRF	Date/Time Created:	7/10/2012

Investigation Finding:	32 Watt T8 Lighting.	Date Identified:	2/16/2012
Description of Finding:	32 Watt T8 Lamps were found throughout the Library.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy savings and load reduction
Baseline Documentation Method:	Visual inspection of the lamps concluded 32 watt T8 lamps are being installed.		
Measure:	Replace 32 watt lamps with 28 watt lamps.		
Recommendation for Implementation:	Replace the 32 watt T8 lamps with 28 watt T8 lamps throughout the Library.		
Evidence of Implementation Method:	Visually inspect the lamps to ensure 28 watt T8 lamps are being installed.		

Annual Electric Savings (kWh): Estimated Annual kWh Savings ($):	2,818 $121	Peak Demand Savings (kWh): Estimated Annual Demand Savings ($):	2 $100
Contractor Cost ($): PBEEEP Provider Cost for Implementation Assistance ($): Total Estimated Implementation Cost ($):	$3,074 $307 $3,381		

Estimated Annual Total Savings ($): Initial Simple Payback (years): Simple Payback w/ Utility Co-Funding (years): GHG Avoided in U.S. Tons (C02e):	$221 15.28 15.28 2	Utility Co-Funding for kWh ($): Utility Co-Funding for kW ($): Utility Co-Funding for therms ($): Utility Co-Funding - Estimated Total ($):	$0 $0 $0 $0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	11.6%	Percent of Implementation Costs:	14.6%

Findings Details

Building: Main Building

FWB Number:	15201	Eco Number:	5
Site:	Northland CTC TRF	Date/Time Created:	7/10/2012

Investigation Finding:	32 Watt T8 Lighting.	Date Identified:	2/16/2012
Description of Finding:	32 Watt T8 Lamps were found throughout the Bookstore.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy savings and load reduction
Baseline Documentation Method:	Visual inspection of the lamps concluded 32 watt T8 lamps are being installed.		
Measure:	Replace 32 watt lamps with 28 watt lamps.		
Recommendation for Implementation:	Replace the 32 watt T8 lamps with 28 watt T8 lamps throughout the Bookstore.		
Evidence of Implementation Method:	Visually inspect the lamps to ensure 28 watt T8 lamps are being installed.		

Annual Electric Savings (kWh):	1,519	Peak Demand Savings (kWh):	1
Estimated Annual kWh Savings ($):	$65	Estimated Annual Demand Savings ($):	$100
Contractor Cost ($):	$1,374		
PBEEEP Provider Cost for Implementation Assistance ($):	$137		
Total Estimated Implementation Cost ($):	$1,512		

Estimated Annual Total Savings ($):	$165	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	9.14	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	9.14	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	1	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	8.7%	Percent of Implementation Costs:	6.5%

Deleted Findings Report

FWB Number:	15201	Eco #:	1	Building:	Main Building
Investigation Finding:	Constant Volume Pumping - CHW Pumps	Equipment or System(s):	Pump, primary CHW (evap-only)		
Measure:	Install variable frequency drive on the chilled water pump. Replace the existing three way chilled water valves on AHUs 1, 2, 3 and 4. Cost of $13,656 with a savings of 12,677 kWh/yr for a 25 year payback.				

FWB Number:	15201	Eco #:	6	Building:	Main Building
Investigation Finding:	Discharge air temperature reset from both Hot deck and cold deck is suboptimal.	Equipment or System(s):	AHU with heating and cooling		
Measure:	Limit difference between hot deck and cold deck to 25F. Cost of $3,115 with a savings of 4,691 therms for a 1 year payback.				

FWB Number:	15201	Eco #:	7	Building:	Main Building
Investigation Finding:	Supply Fan is constantly running	Equipment or System(s):	AHU with heating and cooling		
Measure:	Reschedule the Supply Fan for AHU 3 and 9 to only operate when the building is occupied and cycle on/off during the night as needed. Cost of $546 with a savings of 9,258 kWh and 5,584 therms for a payback of 2 months.				

FWB Number:	15201	Eco #:	8	Building:	Main Building
Investigation Finding:	economizer setpoint for AHU-10 is suboptimal.	Equipment or System(s):	AHU with heating and cooling		
Measure:	Reprogram the economizer set point for AHU-10 to 70F. Cost of $546 with savings of 1,230 kWh and 157 therms for a 3.2 year payback				

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

ATTACHMENT 4: SCREENING RESULTS FOR NORTHLAND COMMUNITY AND TECHNICAL COLLEGE- THIEF RIVER FALLS CAMPUS

NORTHLAND COMMUNITY & TECHNICAL COLLEGE

Minnesota STATE COLLEGES & UNIVERSITIES

February 7, 2011

Campus Overview

Northland Community and Technical College- Thief River Falls	
Location	1101 Highway 1 East, Thief River Falls, MN 56701 (Main Campus) 13892 Airport Drive, Thief River Falls, MN 56701 (Airport Campus)
Facility Manager	Clinton Castle, Director of Facilities
Number of Buildings	24
Interior Square Footage	321,707 (from B3)
PBEEEP Provider	Center for Energy and Environment (Angela Vreeland)
Date Visited	1/20/2011
Annual Energy Cost	$456,866 (from 2009 utility data)
Utility Company	Electric: Thief River Falls Municipal Utility (Main), Red Lake Electric Co-op (Airport) Natural Gas: Minnesota Energy Resources
Site Energy Use Index (EUI)	105 kBtu/sqft (from 2009 utility data)
Benchmark EUI (from B3)	123 kBtu/sqft

Northland Community and Technical College (NCTC) in Thief River Falls is comprised of two campus locations. The Main Campus is made up of nineteen buildings totaling 232,455 square feet. Ten of the buildings are attached and make up the Main Building and the remaining nine are smaller detached buildings. The Airport Campus is made up of five buildings, four of which are attached, and totals 89,252 square feet. The two campuses are at separate locations, approximately five miles apart. There is a map of each of the campuses at the end of this report.

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The screening of NCTC Thief River Falls was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. A walk-through was conducted on January 20, 2011 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and their potential for recommissioning. This report is the result of that information.

Recommendation

A detailed investigation of the energy usage and energy savings opportunities of the 11 buildings listed below totaling 206,958 interior square feet at NCTC Thief River Falls is recommended at this time. The floor areas listed in the table have not been verified.

Building Name	Building Group*	Campus	State ID	Area (sq ft)	Year Built
Activities	Main Building	Main	E26356C1971	23,700	1971
Administration-Library	Main Building	Main	E26356C0269	15,455	1969
Development Learning Center	Main Building	Main	E26356C1502	6,733	2001
Development Learning Center	Main Building	Main	E26356C1401	3,367	2001
Fine Arts	Main Building	Main	E26356C0471	18,800	1971
Main Building	Main Building	Main	E26355T0267	45,384	1967
Science	Main Building	Main	E26356C0169	10,696	1969
Shop/Café/Cosmo	Main Building	Main	E26355T0478	50,956	1978
Student Commons-Classrooms	Main Building	Main	E26356C1300	16,123	2000
Workforce Center	Main Building	Main	E26355T2006	5,200	2007
Multi-Event Cultural Center	MECC	Main	E26356C1299	10,544	1999

*NOTE: The Main Building is comprised of ten buildings, which are all additions to the original Main Building and are all attached. In this report, "Main Building" will refer to the grouping of ten buildings.

There are many factors that are part of the decision to recommend an energy investigation of a building; at NCTC Thief River Falls some of the characteristics that were taken into account during the building selection process include:

- Potential energy savings opportunities observed during screening phase
- Site Energy Use Intensity (EUI) compared to B3 Benchmark EUI
- Large square footage
- Level of control by the building automation system
- Equipment size and quantity
- Support from the staff and management to include building in an investigation

Below is a list of the remaining buildings that are not recommended for investigation. The buildings at the Airport are not being recommended because they have a combined EUI of 63 kBtu/sq ft, which is quite low and likely cannot be significantly reduced at a low cost. The small detached buildings at the Main Campus are not recommended for an investigation because they have little energy use. The Swenson House and garage are not recommended because the buildings are residential in character and are not used at this time.

Building Name	Building Group	Campus	State ID	Area (sq ft)	Year Built
Original Hangar	Main Building*	Airport	E26355T0160	12,252	1960
Hangar Addition	Main Building*	Airport	E26355T0370	4,704	1970
Arctco Hangar	Main Building*	Airport	E26355T0585	10,000	1985
Aviation Class	Main Building*	Airport	E26355T0690	27,296	1990
Aviation Hangar	Swenson Hangar	Airport	E26355T0792	35,000	1992
Grounds Department Shed	N/A	Main	E26356C1896	4,800	2002
Storage Shed NW	N/A	Main	E26356C1196	588	1996
Criminal Justice	N/A	Main	E26356C0371	2,108	1971
Storage Shed NE	N/A	Main	E26356C0990	600	1990
Storage Shed NE	N/A	Main	E26356C1090	600	1990
Storage Shed NW	N/A	Main	E263560785	1,350	1985
Swenson House (Acq FY03)	N/A	Main	E26356C1794	13,043	1994
Swenson House (Garage)	N/A	Main	E26356C1694	2,135	1994

*NOTE: The Main Building at the Airport Campus is not recommended for an energy investigation; however, the equipment in the building is controlled by an outdated automation system and the staff would be interested in upgrading the system to improve control and allow for remote access.

Recommended Buildings Descriptions

Details obtained through the screening process regarding the recommended buildings are included in the following:

Mechanical Equipment

There are a total of 22 air handlers and two rooftop units located throughout the Main Building. There are two boiler rooms that supply hot water to a loop that circulates hot water to the air handlers and reheats located throughout the building. The East and West Boiler rooms each have three hot water boilers. An air-cooled chiller provides chilled water to cooling coils in five of the air handlers. Eleven of the air handlers and both rooftop units have direct expansion (DX) cooling while the remaining six air handlers do not provide cooling. There are approximately 58 VAV boxes with hot water reheat, approximately 15 of which are pneumatically controlled and actuated, while the rest are digital.

The Multi-Event Cultural (MEC) Center has four small boilers and two pumps that produce and deliver hot water to three air handlers. The air handlers provide heating to the spaces, but no cooling. The equipment in the building is oversized because the building was meant to be expanded in phases, with the current structure being the first of three phases. The equipment was sized to handle the load of a much larger space, but there are no longer plans to expand the facility. Variable Frequency Drives (VFDs) were installed recently on the supply fan motors of all of the air handlers to help resolve this issue.

The following table lists the key mechanical equipment in the Main Building and the MEC Center.

Mechanical Equipment Summary Table	
2	Building Automation Systems (TAC and Metasys)
11	Buildings
206,958	Interior Square Feet
22	Air Handlers (3 in MECC)
2	Rooftop Units
43	Digital VAV Boxes
~15	Pneumatic VAV Boxes
29	Exhaust Fans
16	Unit Heaters and Cabinet Unit Heaters
2	Make-up Air Units
1	Chiller
10	Hot Water Boilers (4 in MECC)
15	Pumps (HW, CHW, etc) (2 in MECC)
4	Heat Exchangers
1	Air Compressor
740	Approximate Number of Points Available for Trending
490	Points Required for Trending
90	Data Loggers Required (approximately 10 motor status and 80 temperature). Does NOT include any necessary lighting loggers.

Controls and Trending

The Main Campus originally had a Johnson Controls Metasys Building Automation System (BAS) that controlled most of the equipment in the facility. Recently a new TAC Niagara front end was installed that communicates with the existing controllers and new controllers were installed. The Niagara system is capable of trending, although is it not currently set up for trending and will require set up by a controls technician. The Metasys system is also capable of trending. Since some of the equipment is still controlled by the Metasys system, trending all of the equipment in the facility will require setting up trends on both systems. The trend data can be exported from both systems in a usable format for spreadsheet analysis. Approximately 65% of the equipment in the Main Building is controlled by both systems. The equipment that is neither controlled or monitored by either BAS are seven air handlers and approximately 15 Variable Air Volume (VAV) boxes that are pneumatically controlled and actuated. These items of equipment will require the use of data loggers to collect trend data. All of the equipment in the MEC Center is controlled by the TAC system. The points for each building in the automation system are listed in the following building summary tables.

Lighting

The majority of interior lighting on campus is 32 watt T8s. The MEC Center also has exterior scoreboard lighting and field lights.

Energy Use Index and B3 Benchmark

The site Energy Use Index (EUI) for the Main Campus is 115 kBtu/sqft, which is 12% lower than the B3 Benchmark of 131 kBtu/sqft. This includes the four storage sheds and the Criminal Justice Building, so these values are not for the Main Building alone. The site Energy Use Index (EUI) for the MEC Center is

130 kBtu/sqft, which is 16% higher than the B3 Benchmark of 112 kBtu/sqft. The median site EUI for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks. This indicates that NCTC Thief River Falls has the potential to further reduce its energy use at the Main Building and the MEC Center.

Metering

The Main Building has two electric and five natural gas meters, which also serves some of the small detached buildings on campus, so the Main Building is not individually metered. The MEC Center is individually metered and has one electric and one natural gas meter.

Documentation

There is a significant amount of mechanical documentation, including building plans, equipment schedules, operations and maintenance manuals, and control sequences available on-site. Where capacities in the tables below are listed as unknown it means that neither balance reports nor original mechanical schedules with motor and fan capacities were found during Screening. The building staff has very good knowledge about the documentation and how to locate necessary information for each building.

Building Summary Tables

The following tables are based on information gathered from interviews with facility staff, building walk-throughs, automation system screen-captures, and equipment documentation. The purpose of these tables is to provide the size and quantity of equipment and the level of control present in each building recommended for an investigation. It is complete and accurate to the best of our knowledge.

Main Building State ID# E26356C- 1971,0269,1502,1401,0471,0169,1300 E26355T- 0267,0478,2006					
Area (sqft)	196,414	Year Built	1967-2007	Occupancy (hrs/yr)	3,900
HVAC Equipment					

Description	**Type**	**Size**	**Notes**
AHU 1 Science	Constant Volume Multizone AHU with SF	Unknown cfm 15 hp SF	Glycol heat and CHW, hot deck/cold deck, serves 6 zones in Science.
AHU 2 Journalism	VAV AHU with VFD on SF	Unknown cfm 30 hp SF	CHW only, serves 17 VAV boxes in Journalism.
AHU 3 Library	Constant Volume Multizone AHU with SF	Unknown cfm 15 hp SF	Glycol heat and CHW, hot deck/cold deck, serves 5 zones in Library.
AHU 4 Chemistry	VAV AHU with VFD on SF	Unknown cfm 7.5 hp SF	Glycol heat and CHW, serves Chemistry Rooms111 and 113.
AHU 5 Wellness	Constant Volume AHU with SF	2,800 cfm 3 hp SF	HW and CHW, serves Wellness Center.

HVAC Equipment- Cont'd

Description	Type	Size	Notes
AHU 6 Infield	Constant Volume Partial Dual-Duct AHU with SF	21,100 cfm 40 hp SF	HW and 2-stage DX cooling, serves Infield Rooms, supply dual duct splits and half of area served is hot deck/cold deck and half of area served has the hot deck blocked and cold deck duct serves 15 VAV boxes.
AHU 7 Farm Mgt	Constant Volume AHU with SF	3,910 cfm 5 hp SF	2-stage DX cooling only, serves 5 VAV boxes in Farm Management
AHU 8 Cosmtlgy	VAV AHU with VFDs on SF and RF	4,500 cfm 7.5 hp SF 3 hp RF	Glycol heat and 2-stage DX cooling, serves Cosmetology.
AHU 9 Business	VAV AHU with VFD on SF	6,570 cfm 10 hp SF	2-stage DX cooling, serves pneumatic VAV boxes in Business Office Rooms 551-560.
AHU 10 Commons	VAV AHU with VFD on SF	12, 100 cfm 20 hp SF	HW and 2-stage DX, hot deck/cold deck, serves Commons Area and Rooms 515, 520, 535.
AHU 11 Admin.	Constant Volume AHU with SF	< 1 hp SF	DX only, serves Administration Suite 461.
AHU 12 Human Resources	Constant Volume AHU with SF and RF	7.5 hp SF 3 hp RF	DX only, serves Human Resources Rooms 425, 431, 453, and 455.
AHU 13 Theater	Constant Volume AHU with SF	Unknown cfm 5 hp SF	HW only, serves Theater Room 415.
AHU 14 Music	Constant Volume AHU with SF	Unknown cfm 3 hp SF	HW and DX cooling, serves Music Rooms 401-407.
AHU 15 Gym	Constant Volume AHU with SF	Unknown cfm 15 hp SF	HW only, serves Gym Room 315.
AHU 16 Locker Rms	Constant Volume AHU with SF	Unknown cfm 2 hp SF	HW only, serves Locker Rooms 301 and 311
AHU 17 Training	Constant Volume AHU with SF	Unknown cfm 5 hp SF	HW and DX cooling, serves Training and Classrooms 315-329.
AHU 18 Workforce	VAV AHU with VFD on SF	4,700 cfm 7.5 hp SF	Glycol heat and 2-stage DX cooling, serves 6 VAV boxes in Workforce Addition.
AHU 1 Automotive	VAV AHU with VFDs on SF and EF	13,000 cfm 15 hp SF 10 hp EF	Glycol heat, energy recovery coil, serves Automotive Room 721.
AHU 2 Autobody	VAV AHU with VFDs on SF and EF	3,100 cfm 5 hp SF 3 hp EF	Glycol heat, energy recovery coil, serves Auto Body Shop 719.
AHU 3 Autobody	VAV AHU with VFDs on SF and EF	6,600 cfm 10 hp SF 5 hp EF	Glycol heat, energy recovery coil, serves Auto Body Shop 717.
AHU 4 Drafting	VAV AHU with VFDs on SF and EF	11,965 cfm 15 hp SF 7.5 hp EF	2-stage DX cooling, serves 12 VAV boxes in Drafting.
RTU 1 Kitchen	Constant Volume RTU with SF	10,000 cfm 15 hp fan	HW and DX cooling, serves Kitchen and Cafeteria.

HVAC Equipment- Cont'd			
Description	**Type**	**Size**	**Notes**
RTU 2 Student Svc	VAV RTU with VFD on SF	2,510 cfm 3 hp SF	2-stage DX cooling, serves Student Services.
43 Digital VAV Boxes	Variable Air Volume Boxes		Digitally actuated and controlled, HW reheat
~15 Pneumatic VAV Boxes	Variable Air Volume Boxes		Pneumatically actuated and controlled, HW reheat, some served by AHU 9. ***Not controlled by the BAS.***
Welding MAU	Make-up Air Units	14,000 cfm 15 hp fan	Direct-fired, natural gas, serves Welding Room 651
E Boiler MAU	Make-up Air Units	2,500 cfm 3 hp fan	Direct-fired, natural gas, serves East Boiler Room, linked to CO sensor.
29 EFs	Exhaust Fans	< 1.5 hp ea	
Boilers 1, 2, and 3	Thermal Solutions HW Boilers	1,000 kBtu/hr each	"East Boilers," feed building HW loop.
Boiler 4	Kewanee HW Boiler	6,650 kBtu/hr	Located in West Boiler room, least efficient and largest boiler, used rarely for morning warm-up in extremely cold weather.
Boilers 5 and 6	Thermal Solutions HW Boilers	2,000 kBtu/hr each	Located in West Boiler room, feed building HW loop.
HWP 2 HWP 3	Constant Volume HW Pumps	Unknown hp	
HWP 5 HWP 6	Constant Volume HW Pumps	20 hp	Primary loop pumps for West Boilers (Boilers 5-6).
HWP 7	Constant Volume HW Pump	5/3 hp	HW pump for Boiler 4
HWP 8 HWP 9	Variable Volume HW Pumps	15 hp each	Primary loop pumps for East Boilers (Boilers 1-3).
HWP 10 HWP 11	Constant Volume HW Pumps	7.5 hp each	Circulate HW to Administration Area
HWP 12 HWP 13		Unknown hp	
Glycol Pump	CV Glycol Circulation Pump	11 gpm	
1 Chiller	Air-cooled Rotary Chiller	125 Tons	
CWP 1	Constant Volume CHWP	Unknown hp	
4 HXs	Hot Water to Glycol Flat-Plate Heat Exchangers		Glycol is used in AHUs 1 (Science), 3 (Library), 4 (Chemistry), 8, 18, and 1-4 (Automotive, Autobody, and Drafting)
4 CUHs	Cabinet Unit Heaters		1 is glycol heat, the rest are HW
12 UHs	Unit Heaters	10000-63,000 kBtu/hr each	9 use Natural Gas, 3 use HW
Air Compressors		(1) 3 hp	

Points on BAS	
Description	**Points**
AHU 1 Science	Mixed air damper position, MAT, Preheat valve, Preheat temp, SF status, Hot deck valve, Cold deck valve, Hot deck temp, Cold deck temp, Occupancy, Min damper position, Economizer setpoint, Preheat temp setpoint, Warmest zone temp, Calc CD supply setpoint, Coldest zone temp, Calc HD supply setpoint, Zone temps (6), Zone setpoints (6), Zone damper position (6)
AHU 2 Journalism	Mixed air damper position, MAT, Cooling valve, SF status, SF VFD speed, DAT, DA DSP, Coldest zone temp, Occupancy, Min damper position, Economizer setpoint, DAT setpoint, DA DSP setpoint
AHU 3 Library	Mixed air damper position, MAT, SF status, Hot deck valve, Cold deck valve, Hot deck temp, Cold deck temp, Occupancy, Zone temp, Min damper position, Economizer setpoint, Warmest zone temp, Calc CD supply setpoint, Coldest zone temp, Calc hot deck setpoint, Zone temps (5), Zone setpoints (5), Zone damper position (5)
AHU 4 Chemistry	OA damper (on/off), Cooling valve, Heating valve, SF status, SF VFD speed, DAT, Zone temp, Supply damper status (3), Radiation valve, Occupancy, Zone temp setpoint, DAT setpoint
AHU 5 Wellness	Mixed air damper position, MAT, Heating valve, Cooling valve, SF status, DAT, Occupancy, Min damper position, Economizer setpoint, DAT setpoint, Zone temp setpoint
AHU 6 Infield	RAT, Mixed air dampers, MAT, SF status, Hot deck valve, DX cooling stage (2), Hot deck temp, Cold deck temp, Occupancy, Cold deck setpoint, Calc hot deck setpoint, Min damper position, Economizer setpoint, OA low limit, OA high limit, Hot deck low limit, Hot deck high limit
AHU 7 Farm Mgt	Mixed air dampers, MAT, DX cooling stage (2), SF status, DAT, Warmest zone temp, Occupancy, Min damper position, Economizer setpoint, DAT low limit, DAT reset band, Zone temp setpoint, Calc DAT setpoint
AHU 8 Cosmtlgy	RF status, RF VFD speed, RA CO2, Mixed air dampers, MAT, SF status, SF VFD speed, DX cooling stage (2), Heating valve, DAT, Zone temp, Zone setpoint, Occupancy, Min damper position, Economizer setpoint, VFD min speed, Night setup setpoint, Night setback setpoint, DAT low limit, DA calc reset, Remote room setpoint, CO2 mixed air reset band
AHU 9 Business	RA CO2, RAT, Mixed air dampers, MAT, SF status, SF VFD speed, DX cooling stage (2), DAT, DA DSP, Zone temp, Occupancy, Min damper position, Economizer setpoint, VFD min speed, DA DSP setpoint, Night setup setpoint, Night setback setpoint, DA low limit, DA reset band, CO2 mixed air reset band
AHU 10 Commons	RA CO2, Mixed air dampers, MAT, SF status, SF VFD speed, Hot deck valve, DX cooling stage (2), Hot deck temp, Cold deck temp, Zone tstat pressure feedback, Zone temp, Occupancy, Min damper position, Economizer setpoint, CO2 mixed air reset band, Min VFD speed, Calc CD supply setpoint, Calc HD supply setpoint, Night setup setpoint, Night setback setpoint
AHUs 11-17	***There are no points available for trending for these units because they only have pneumatic controls.***
AHU 18 Workforce	RA CO2, RAT, Mixed air dampers, OA flow, MAT, Hot deck valve, DX cooling stage (2), SF status, SF VFD speed, DAT, DA DSP, Coldest zone temp, Occupancy, Min damper position, Economizer setpoint, DAT setpoint, DA DSP setpoint, CO2 low limit, CO2 reset band

Points on BAS- Cont'd

Description	Points
AHU 1 Automotive, AHU 2 & 3 Autobody	RAT, EF status, EF VFD speed, EAT, Mixed air dampers, OAT, Preheat valve, ERU discharge temp, Heating valve, SF status, SF VFD speed, DAT, Occupancy, SF VFD speed setpoint, EF VFD speed setpoint, Calc DAT setpoint, Night setback setpoint, Remote room setpoint, EAT setpoint, Zone temp, Local temp setpoint
AHU 4 Drafting	RAT, RF status, RF VFD speed, Mixed air dampers, DX cooling stage (2), SF status, SF VFD speed, DAT, DA DSP, HX HWST, HX HWRT, HX HWST setpoint, Occupancy, Min damper position, Economizer setpoint, DAT setpoint, DA DSP setpoint
RTU 1 Kitchen	RAT, Mixed air dampers, SF status, DAT, Occupancy, Min damper position, Economizer setpoint, DAT low limit, DAT reset band, DAT setpoint, Zone temp setpoint, Zone temp
RTU 2 Student Svc	RA CO2, RAT, Mixed air dampers, MAT, SF status, SF VFD speed, DX cooling stage (2), DAT, DA DSP, Zone temp, Occupancy, Min damper position, Economizer setpoint, VFD min speed, DA DSP setpoint, Night setup setpoint, Night setback setpoint, DAT low limit, DAT reset band, CO2 mixed air reset band
Digital VAV Boxes	CFM flow setpoint, CFM flow, Damper position, Heating valve, Zone temp, Zone temp setpoint, Occupancy
Welding MAU, E Boiler MAU	***There are no points available for trending for these units because they are not controlled by the BAS.***
EFs	EF status
East Boiler HW System	Boiler command (3), Calc boiler setpoint (3), HWP 8 status, HWP 8 VFD speed, HWP 9 status, HWP 9 VFD speed, HWST, HWS pressure, HWS pressure setpoint, OAT low limit, OAT high limit, Boiler HWST low limit, Boiler HWST high limit
West Boiler HW System	Boiler command (3), Calc boiler setpoint (3), HWP 2 command, HWP 3 command, HWP 10 command, HWP 11 command, HWP 12 command, HWP 13 command, HWP 5 command, HWP 6 command, HWST, OAT low limit, OAT high limit, Boiler HWST low limit, Boiler HWST high limit
Chilled Water System	Chiller lockout setpoint, Chiller command
4 CUHs	***There are no points available for trending for these units because they are not controlled by the BAS.***
12 UHs	***There are no points available for trending for these units because they are not controlled by the BAS.***
Air Compressors	***There are no points available for trending for these units because they are not controlled by the BAS.***

Multi-Event Cultural Center State ID# E26356C1299					
Area (sqft)	10,544	Year Built	1999	Occupancy (hrs/yr)	Variable*

HVAC Equipment

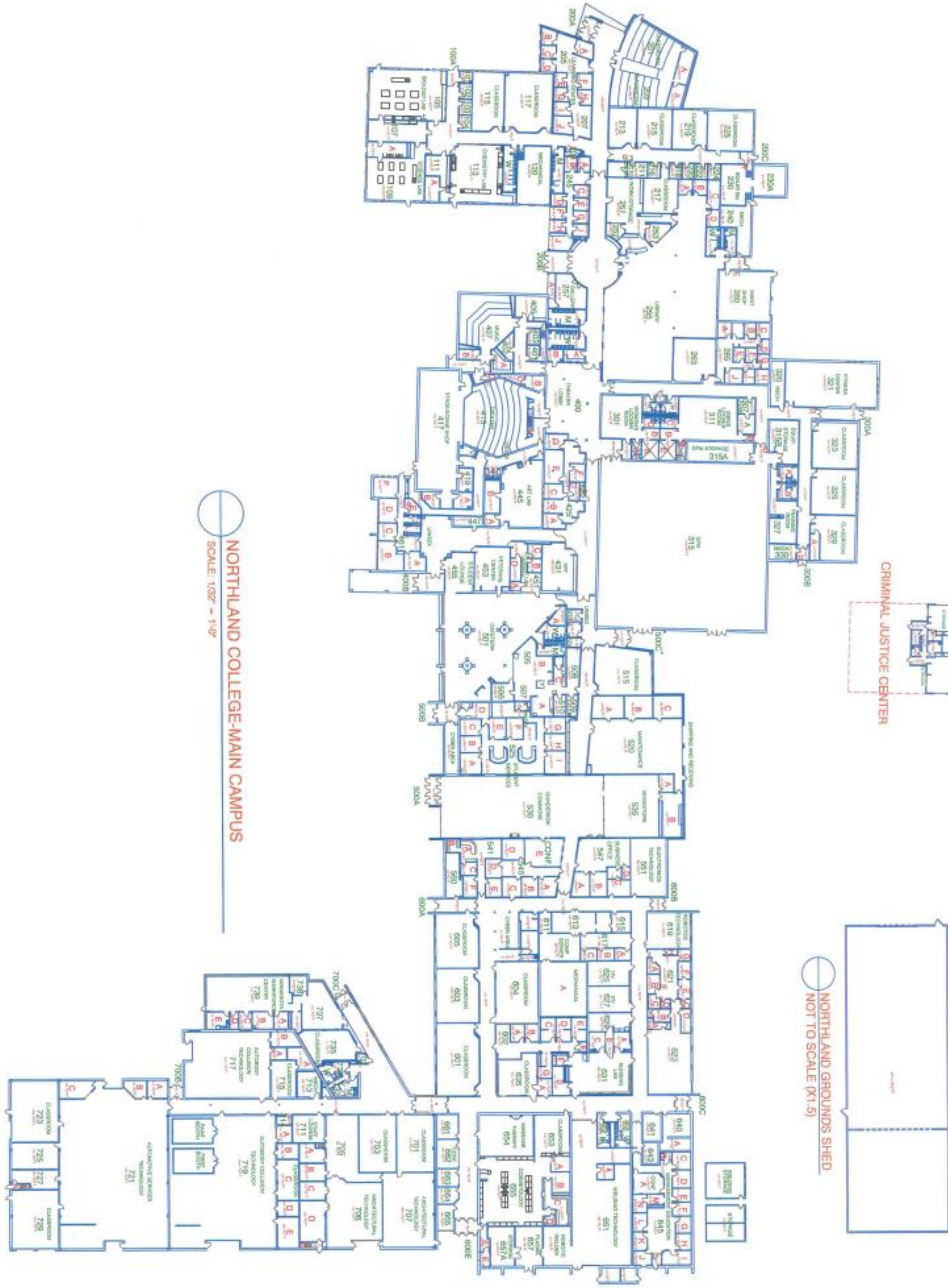
Description	Type	Size	Notes
AHU 1	VAV AHU with VFD on SF	4,200 cfm 3 hp SF	HW, serves locker rooms.
AHU 2	VAV AHU with VFD on SF	1,200 cfm 0.5 hp SF	HW, serves rest rooms.
AHU 3	VAV AHU with VFD on SF	5,350 cfm 5 hp SF	HW, serves concourse and corridor.
Boiler 1 Boiler 2 Boiler 3 Boiler 4	HW Boilers	396 kBtu/hr input 275 kBtu/hr output	
P 1 P 2	Variable Volume HW Pumps with VFDs	84 gpm 3 hp each	Serve primary loop

Points on BAS- Cont'd

Description	Points
AHU 1 AHU 2 AHU 3	RAT, Mixed air dampers, MAT, Heating valve, SF status, SF VFD speed, DAT, Highest zone temp, Occupancy, Unocc heating setpoint, Highest room setpoint, Min damper position, Economizer setpoint
Heating System	Boiler status (4), Pump status (2), Pump VFD speed (2), HWST setpoint, HWST, Unocc OAT pump shutdown setpoint, Occ OAT pump shutdown setpoint

*This building is used primarily in the afternoons and weekends for football (fall) and track (spring) events.

Building Map- Main Campus



PBEEEP
State Government

Building Map- Airport Campus

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	hp	Horsepower
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temperature	HWRT	Hot Water Return Temperature
cfm	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CV	Constant Volume	MAT	Mixed Air Temperature
DA	Discharge Air	MAU	Make-up Air Unit
DA Enth	Discharge Air Enthalpy	OA	Outside Air
DARH	Discharge Air Relative Humidity	OA Enth	Outside Air Enthalpy
DAT	Discharge Air Temperature	OARH	Outside Air Relative Humidity
DDC	Direct Digital Control	OAT	Outside Air Temperature
DP	Differential Pressure	Occ	Occupied
DSP	Duct Static Pressure	PTAC	Packaged Terminal Air Conditioner
DX	Direct Expansion	RA	Return Air
EA	Exhaust Air	RA Enth	Return Air Enthalpy
EAT	Exhaust Air Temperature	RARH	Return Air Relative Humidity
Econ	Economizer	RAT	Return Air Temperature
EF	Exhaust Fan	RF	Return Fan
Enth	Enthalpy	RH	Relative Humidity
ERU	Energy Recovery Unit	RTU	Rooftop Unit
FCU	Fan Coil Unit	SF	Supply Fan
FPVAV	Fan Powered VAV	Unocc	Unoccupied
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes

Conversions
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH